REMARKS

Claims 13-25 were previously pending in the application. Claim 25 is amended and claims 26-34 are added. Claims 13-24 remain unchanged. Claims 13, 23, 24, 25, and 32 are independent.

Statement of the Substance of the Interview

Applicants' representative thanks Examiner Brian W. Jennison and Supervisory Patent Examiner Tu B. Hoang for the courtesies extended in the personal interview conducted with Applicants' Representative, John J. Dresch, Reg. No. 46,672, on February 4, 2010. A copy of an Interview Summary was provided by the Examiner at the interview. Applicants submit this Statement to comply with the requirements of M.P.E.P. § 713.04.

In the interview, the following was discussed:

A. Identification of claims discussed:

Claims 13, 16, 17, 23, and 25

B. Identification of prior art discussed:

Cage et al.

C. Identification of principal proposed amendments:

None.

D. Brief Identification of principal arguments:

Applicants argued the traversal positions set forth below.

E. Results of the Interview:

The Examiner kindly clarified the rejections and suggested amendments for advancing prosecution. Particularly, the Examiner suggested amending the claims to include the second scaling means and the second detector means from claim 17 and also incorporating language from paragraphs [0018] and [0035] to further clarify how the circuit operates. The Examiner also suggested further defining the independent claims to include a circuit in combination with a heater.

No formal agreement was reached.

New Claims

New claims 26-34 are added to define more clearly the features of the invention in accordance with the Examiner's very helpful suggestions in the personal interview. No new matter is added. See, e.g., paragraphs [0018], [0019], and [0035] to [0037].

Applicants respectfully submit that none of the applied references discloses or suggests the subject matter defined by claims 26-34 for at least the same reasons as set forth below with respect to claims 1-25, as well as for the additional features recited therein.

Particularly, the applied references do not disclose or suggest at least the combination of the second scaling means and the second detector means, the manner in which the claimed circuit operates, or a circuit in combination with a heater, as claimed.

Applicants respectfully request allowance of the claims.

The Claimed Invention

An exemplary embodiment of the claimed invention, as recited by, for example, independent claim 13, is directed to a circuit arrangement for protecting from overheating a heating element whose resistance value is a function of its temperature, the circuit arrangement comprising a current sensor means coupled to the heating element, the output of the current sensor providing a signal proportional to the current flowing through the heating element; a first scaling means whose output provides a signal proportional to a the supply voltage of the heating element; a first detector means having inputs each coupled to an output of a respective one of the current sensor means and the first scaling means, the first detector means having an output that provides *a difference signal* formed from the signals of the current sensor means and the scaling means; and an evaluation circuit operable to compare *the difference signal* determined by the first detector means with a reference signal, the switch control circuit being operatively connected to the evaluation circuit such that the switch control circuit can be switched from the first state into the second state by the evaluation circuit.

The present invention provides an electronic fuse for the fused protection against damage of a heating device for fluids comprising a heating element. In this method, the resistance value of the heating element is a function of its temperature and the change in the resistance is detected and compared with a reference signal. Depending on the comparison, the heating circuit is optionally interrupted by means of a switching means.

As explained in the present application, it is not possible to directly measure the resistance of the heating element since this is acted upon by the supply voltage during operation. The resistance must therefore be calculated indirectly by measuring the current through the heating element and the voltage at the heating element. The present invention explains that, according to Ohm's law, the ratio of voltage to current must be determined for this purpose. However, while it is possible to determine the ratio of voltage to current, this process is laborious.

Therefore, instead of determining the ratio of voltage to current, the present invention uses an approximation of ratio formation (division) by a Taylor series expansion and discontinues this after the second term. Instead of using the ratio or division, the present invention uses a subtraction of voltage and current (i.e., a difference signal) which can be implemented very simply in circuit technology by the first detector means. This means that a descending line is obtained from the division hyperbola. The error thereby incurred does not play a fundamental role for the function of the circuit arrangement if both terms are normalised to the same quantity before the analogue subtraction of voltage and current. This is achieved on the one hand by the first scaling means which normalises the current. The operating voltage of the heating element can be reduced to the desired value by a voltage divider, which is the first scaling means. The current through the heating element flows through a shunt across which a voltage proportional to the current is produced. See, e.g., page 4, lines 9-22, paragraph [018].

In this manner, the present invention provides a circuit arrangement for protecting a heating element from overheating which is simple, fast and cost-effective, thereby providing a heating element protected from overheating and a method for protecting such a device. See, e.g., page 2, lines 23-25; and page 7, lines 11-15.

The Rejections under 35 U.S.C. § 102

In the Office Action, claims 13-15, 22, 23, and 25 are rejected under 35 U.S.C. 102(b) as being anticipated by the Cage et al reference (US 4,198,957). Claim 24 is rejected under 35 U.S.C. 102(b) as being anticipated by the Gava et al reference (EP 0 579 947).

Applicants respectfully traverse these rejections.

The Rejection over the Cage et al reference

Claims 13-15, 22, 23, and 25 are rejected under 35 U.S.C. 102(b) as being anticipated by the Cage et al reference.

Applicants respectfully traverse this rejection.

A claim is anticipated only if each and every element as set forth in the claim is found, either expressly or inherently described, in a single prior art reference. [...] The identical invention must be shown in as complete detail as is contained in the ... claim." M.P.E.P. § 2131.

Applicants respectfully submit that the Cage et al reference does not disclose the features of the claimed invention including a current sensor means coupled to the heating element, the output of the current sensor providing a signal proportional to the current flowing through the heating element; a first scaling means whose output provides a signal proportional to a the supply voltage of the heating element; a first detector means having inputs each coupled to an output of a respective one of the current sensor means and the first scaling means, the first detector means having an output that provides *a difference signal* formed from the signals of the current sensor means and the scaling means; and an evaluation circuit operable to compare *the difference signal* determined by the first detector means with a reference signal, the switch control circuit being operatively connected to the evaluation circuit such that the switch control circuit can be switched from the first state into the second state by the evaluation circuit, as recited in independent claim 13.

As explained above, instead of using the ratio or division, the present invention uses a subtraction of voltage and current (i.e., a difference signal) which can be implemented very simply in circuit technology by the first detector means. See, e.g., page 4, lines 9-22, paragraph [018]. These features are important for providing a method for protecting a heating element from overheating which is simple, fast and cost-effective. See, e.g., page 2, lines 23-25; and page 7, lines 11-15.

Contrary to the assertions in the Response to Arguments of the final Office Action, Applicants respectfully submit that the Cage et al reference does not disclose or suggest all of the features of independent claims 13 and 23.

The Cage et al reference does not disclose or suggest at least the first detector means having an output that provides *a difference signal* formed from the signals of the current sensor means and the scaling means; and an evaluation circuit operable to compare *the difference signal* determined by the first detector means with a reference signal, as recited for example in claim 13.

Contrary to the assertions in the Office Action, Applicants respectfully submit that the Cage et al reference does not disclose that the resistor 37 is tapped for measuring current and provides a signal proportional to the heating element. More particularly, the Cage et al reference does not disclose the first detector means having an output that provides *a difference signal formed from the signals of the current sensor means and the scaling means*.

Instead and in contrast to the claimed invention, the Cage et al reference discloses that if the operating temperature of the element 13 exceeds the set value due to thermal overshoot upon removal of the element 13 from contact with skin tissue, the *phase* of the error signal 33 with respect to the applied line signal reverses, thereby triggering the pulse generators to supply conduction-initiating pulses to the gage electrodes of the controlled rectifiers 21, 23 during alternate half cycles when the rectifiers are back biased. This decreases the power to the element 13 and causes the operating temperature to drop to the set value.

First, in the Response to Arguments, the final Office Action asserts that the "subtraction of voltage and current is not stated in the claim only comparing the difference by using an evaluation circuit." Applicants respectfully traverse this position.

Contrary to the assertions in the Office Action, Applicants respectfully note that independent claim 13 very clearly recites:

> *a current sensor means* coupled to the heating element, the output of the current sensor providing a signal proportional to the **current** flowing through the heating element;
>
> *a first scaling means* whose output provides a signal proportional to a the **supply voltage** of the heating element;
>
> a first detector means having inputs each coupled to an output of a respective one of the current sensor means and the first scaling means, the first detector means having an output that provides *a difference signal formed from the signals of the current sensor means and the scaling means*; and
>
> an evaluation circuit operable to compare the difference signal determined by the first detector means with a reference signal, ...

Emphasis added.

Hence, contrary to the assertions in the Office Action, Applicants respectfully submit that claim 13 very clearly recites the first detector means having an output that provides *a difference signal formed from the signals of the current sensor means and the scaling means*. The output of the current sensor is a signal proportional to the **current** flowing through the heating element, and the output of the first scaling means is a signal proportional to a **supply voltage** of the heating element.

Second, in the Response to Arguments, the final Office Action further alleges that, in the Cage et al reference, the threshold detector will use a difference circuit since it is comparing signals to activate the trigger generators. Citing column 3, Lines 15-40.

However, Applicants respectfully submit that simply comparing *any* two signals does not meet the limitations of the claims. As explained above, and described at col. 3, lines 15-40 upon which the Examiner relies, the Cage et al references states that the

control signal 33 is either *in phase or out of phase* with the applied line signal. The Cage et al reference discloses that if the operating temperature of the element 13 exceeds the set value due to thermal overshoot upon removal of the element 13 from contact with skin tissue, the *phase* of the error signal 33 with respect to the applied line signal reverses, thereby triggering the pulse generators to supply conduction-initiating pulses to the gage electrodes of the controlled rectifiers 21, 23 during alternate half cycles when the rectifiers are back biased. This decreases the power to the element 13 and causes the operating temperature to drop to the set value.

In stark contrast, claim 13 very clearly recites the first detector means having an output that provides *a difference signal* ***formed from the signals of the current sensor means and the scaling means***. Claim 13 recites that the output of the current sensor is a signal proportional to the current flowing through the heating element, and the output of the first scaling means is a signal proportional to a the supply voltage of the heating element.

Hence, Applicants respectfully submit that the Cage et al reference fails to disclose these features.

Third, in the Response to Arguments, the final Office Action further alleges that the current senor means allegedly are not specified and that, based on the claim language, any part of the device which current runs through and may be measured through including a resistor can be used since a resistor is easily and commonly used to sense current through.

In contrast to these assertions, Applicants respectfully submit that the means must perform the stated function, which clearly is recited as providing a difference signal from the signals of the current sensor means and the scaling means.

Applicants respectfully note that independent claim 25 does NOT recite means-plus-function language. Hence, the Examiner's Response to Arguments regarding "means-plus-function" language clearly is not applicable to the features of independent claim 25.

Independent Claim 25

This Amendment amends independent claim 25 to define more clearly that a circuit arrangement in combination with a heating element, the circuit arrangement for protecting from overheating the heating element whose resistance value is a function of its temperature, in accordance with the Examiner's helpful suggestions in the personal interview.

Claim 25 recites, inter alia, a circuit arrangement including the heating element; [...] a first scaling device having an output that provides a signal proportional to a supply voltage of the heating element; a first detector having inputs each coupled to an output of a respective one of the current sensor and the first scaling device, the first detector having an output that provides a difference signal formed from the signals of the current sensor and the scaling device; and an evaluation circuit operable to compare the difference signal determined by the first detector with a reference signal, the switch control circuit being operatively connected to the evaluation circuit such that the switch control circuit can be switched from the first state into the second state by the evaluation circuit. The evaluation circuit includes a second detector having two inputs and one output, wherein the output signal of the first detector is supplied to one input and the reference signal is supplied to the other input, and wherein the output forms the output of the evaluation circuit; and a second scaling device that sets the reference signal.

Applicants respectfully submit that the Cage et al reference does not disclose at least a circuit arrangement including the heating element, or the evaluation circuit including a second detector having two inputs and one output, wherein the output signal of the first detector is supplied to one input and the reference signal is supplied to the other input, and wherein the output forms the output of the evaluation circuit; and a second scaling device that sets the reference signal, as recited in claim 25.

Fourth, in the Response to Arguments, the final Office Action further alleges that, in response to our reply regarding the first detector means on page 12-13 of Amendment A, the resistor 37 allegedly provides a current which ***can*** be used as a part of a difference signal.

Applicants respectfully submit that the Cage et al reference does not disclose a first detector means having an output that provides *a difference signal* ***formed from the signals of the current sensor means and the scaling means***. Applicants respectfully submit that whether the Cage et al reference can be modified to perform this function is not relevant for a rejection under 35 USC 102.

For at least the foregoing reasons, Applicants respectfully submit that the Cage et al reference fails to disclose at least these features of independent claims 13, 23, and 25.

Applicants respectfully request withdrawal of this rejection.

The Rejection over the Gava et al reference

Claim 24 is rejected under 35 U.S.C. 102(b) as being anticipated by the Gava et al reference. Applicants respectfully traverse this rejection.

A claim is anticipated only if each and every element as set forth in the claim is found, either expressly or inherently described, in a single prior art reference. [...] The identical invention must be shown in as complete detail as is contained in the ... claim." M.P.E.P. § 2131.

Independent claim 24 recites a method comprising detecting change in the resistance using *a difference signal* formed from a signal proportional to a current flowing through the heating element and a signal proportional to a supply voltage of the heating element; and comparing the detected change in the resistance with a reference signal and selectively interrupting the heating circuit by means of a switch means in dependence upon the comparison of the detected change in the resistance with a reference signal.

As explained above, instead of using the ratio or division, the present invention uses a subtraction of voltage and current which can be implemented very simply in circuit technology by the first detector means. See, e.g., page 4, lines 9-22, paragraph [018]. These features are important for providing a method for protecting a heating element from overheating which is simple, fast and cost-effective. See, e.g., page 2, lines 23-25; and page 7, lines 11-15.

As with the rejection above, the Response to Arguments of the final Office Action alleges that the voltage is not within the claim limitations. Applicants submit that independent claim 24 very clearly recites a method comprising detecting change in the resistance using ***a difference signal*** formed from a signal proportional to a ***current*** flowing through the heating element and a signal proportional to a ***supply voltage*** of the heating element; and comparing the detected change in the resistance with a reference signal and selectively interrupting the heating circuit by means of a switch means in dependence upon the comparison of the detected change in the resistance with a reference signal.

Additionally, the Response to Arguments of the final Office Action alleges that the Gava et al reference discloses using two signals that are compared and that a difference is used. The difference signal allegedly is formed out of a current through a change in resistance in a heating element, and that the current signal in the heating element may be used for any type of signal.

Applicants respectfully submit that the Gava et al reference very clearly does not disclose at least these features of independent claim 24. Instead, the Gava et al reference discloses that the microprocessor 17 is arranged to compute the ratio between said voltage signal and said current signal.

In contrast, the claimed invention is configured to use a **subtraction** of voltage and current (i.e., a difference signal) which can be implemented very simply in circuit technology by the first detector means, NOT a ratio or division.

Indeed, the present invention specifically explains that, according to Ohm's law, the ratio of voltage to current must be determined for this purpose, which is possible but laborious. In contrast, the specification explains that the invention uses an approximation of ratio formation (division) by a Taylor series expansion and discontinues this after the second term. The division is thus replaced by a **subtraction** which can be implemented very simply in circuit technology by the first detector means. See, e.g., page 4, lines 9-22, paragraph [018].

Applicants submit that the Gava et al reference very clearly does not disclose a method comprising detecting change in the resistance using a difference signal formed from a signal proportional to a current flowing through the heating element and a signal proportional to a supply voltage of the heating element, as recited by independent claim 24. As explained above, these features are important for providing a circuit arrangement for protecting a heating element from overheating which is simple, fast and cost-effective. See, e.g., page 2, lines 23-25; and page 7, lines 11-15.

Applicants respectfully request withdrawal of this rejection.

The Rejections under 35 U.S.C. § 103

In the Office Action, claims 16-17, 19, 21 are rejected under 35 U.S.C. 103(a) as being unpatentable over the Cage reference in view of the Luy et al reference (US 4,035,692). Claims 18 and 20 are rejected under 35 U.S.C. 103(a) as being unpatentable over the Cage reference, the Luy et al reference, and in further view of the Abe et al reference (US 4,516,543).

Applicants respectfully traverse these rejections.

Applicants respectfully submit that none of the applied references discloses or suggests the features of the claimed invention including a circuit arrangement comprising a current sensor means coupled to the heating element, the output of the current sensor providing a signal proportional to the current flowing through the heating element; a first scaling means whose output provides a signal proportional to a the supply voltage of the heating element; a first detector means having inputs each coupled to an output of a respective one of the current sensor means and the first scaling means, the first detector means having an output that provides a difference signal formed from the signals of the current sensor means and the scaling means; and an evaluation circuit operable to compare the difference signal determined by the first detector means with a reference signal, the switch control circuit being operatively connected to the evaluation circuit such that the switch control circuit can be switched from the first state into the second

state by the evaluation circuit, as recited in independent claim 13, from which claims 16-21 depend.

As explained above, instead of using the ratio or division, the present invention uses a subtraction of voltage and current (i.e., a difference signal) which can be implemented very simply in circuit technology by the first detector means. See, e.g., page 4, lines 9-22, paragraph [018]. These features are important for providing a method for protecting a heating element from overheating which is simple, fast and cost-effective. See, e.g., page 2, lines 23-25; and page 7, lines 11-15.

The Cage reference very clearly does not teach or suggest these features at least for the reasons set forth above.

Applicants respectfully submit that the Luy et al reference and the Abe et al reference do not remedy the deficiencies of the Cage reference. Indeed, the Office Action does not rely on these references for these features of the claimed invention. Moreover, Applicants respectfully submit that one of ordinary skill in the art would not have combined the applied references in the manner alleged.

None of the applied references discloses or suggests the subject matter defined by independent claim 13, from which claims 16-21 depend.

Applicants respectfully request withdrawal of these rejections.

CONCLUSION

In view of the above, entry of the present Amendment and allowance of Claims 13-34 are respectfully requested. If the Examiner has any questions regarding this amendment, the Examiner is requested to contact the undersigned. If an extension of time for this paper is required, petition for extension is herewith made.

Respectfully submitted,

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